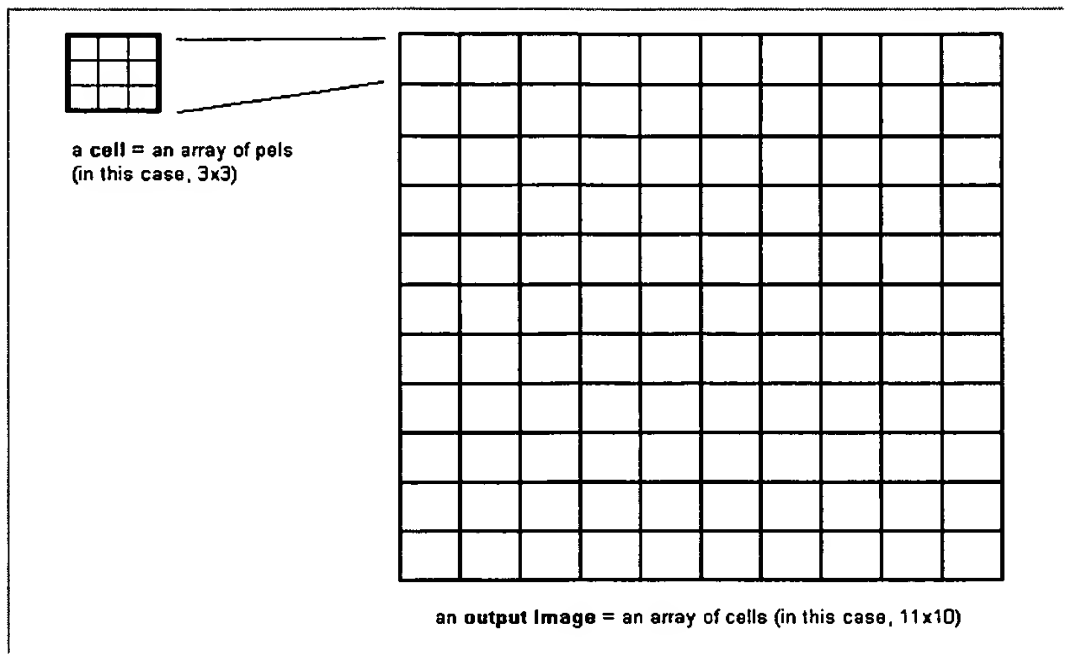
Remarks

For the reasons stated herein, Applicants respectfully request that the Examiner reconsider the rejections set forth in the final Office Action. Claims 1-35 remain pending.

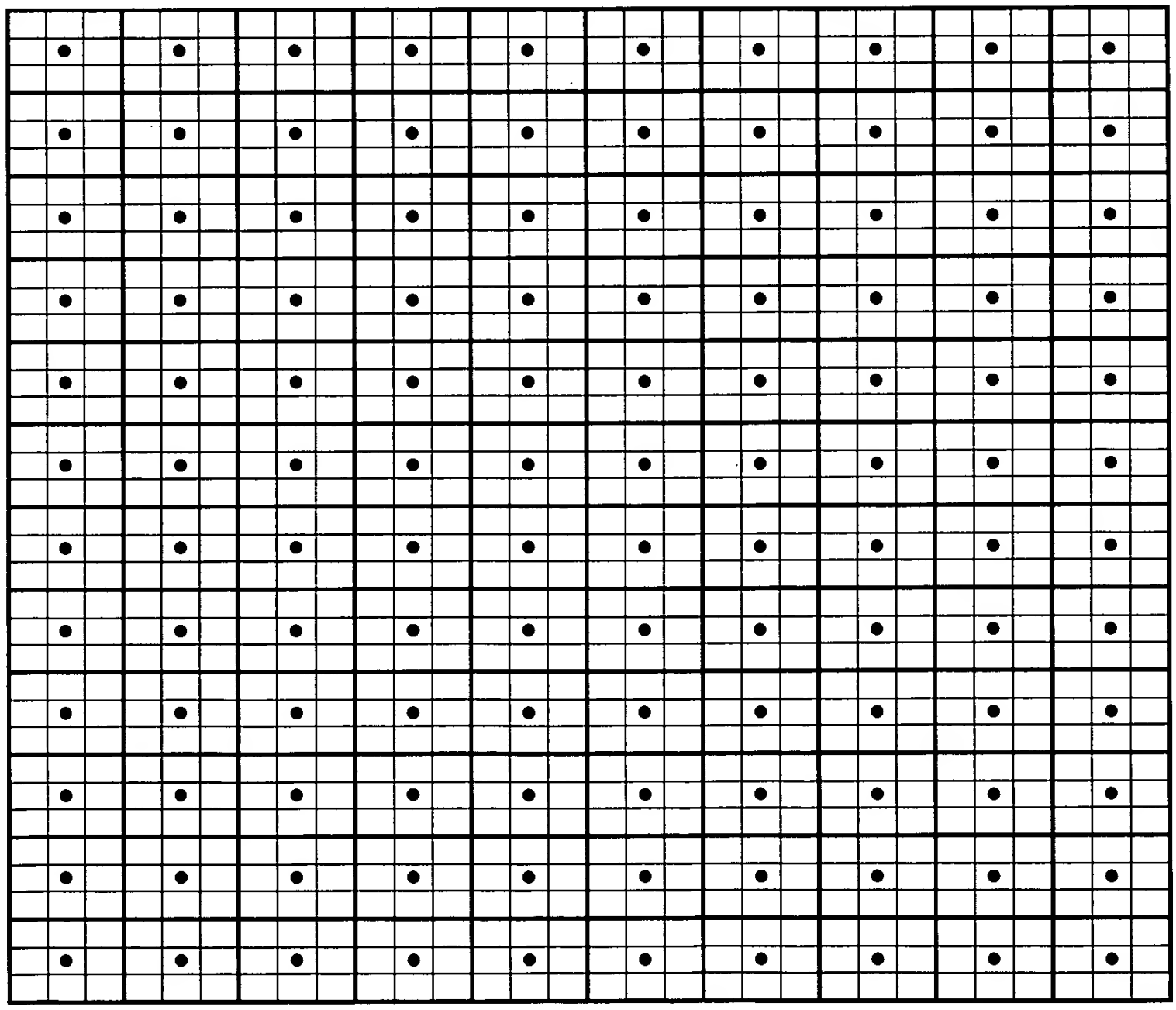
Initially, Applicants gratefully acknowledge the indication of allowability of claims 8-10, 22 & 34 if rewritten into independent form including all the limitations of the base claim and any intervening claims. Presently, these dependent claims have not been rewritten into independent form since the amended independent claims from which they ultimately depend are believed to be in condition for allowance for the reasons stated below.

In the Office Action, claims 1, 16 & 28 were newly rejected under 35 U.S.C. §102(b) as being anticipated by Sugino (U.S. Patent No. 4,897,736; hereinafter Sugino); while claim 30 was rejected under 35 U.S.C. §103(a) as being unpatentable over Sugino; claims 11, 12, 14, 15, 23, 24, 26, 27, 29 & 35 were rejected under 35 U.S.C. §103(a) as being unpatentable over Sugino in view of Abe (U.S. Patent No. 5,805,305; hereinafter Abe); claims 2, 3, 5, 6, 17, 18, 20, 21, 31 & 32 were rejected under 35 U.S.C. §103(a) as being unpatentable over Sugino as applied to claims 1, 16 & 30, and further in view of Abe; and claims 4, 7, 13, 19, 25 & 33 were rejected under 35 U.S.C. §103(a) as being unpatentable over Sugino in view of Abe as applied to claims 2, 5, 11, 17, 23 & 31, and further in view of Sakurada et al. (U.S. Patent No. 4,672,432; hereinafter Sakurada). Each of these rejections is respectfully, but most strenuously, traversed and reconsideration thereof is requested.

To again facilitate an understanding of the present invention, the following simplified examples are provided. Two methods for halftoning are summarized below, i.e., a first method referred to as a "one-to-many" method, and a second method referred to as a "one-to-one" method. Both methods group output pels into cells. An output image is composed of a large number of these cells, arranged in a two-dimensional array.



A key characteristic of the "one-to-many" technique is that each intensity value in the input data array is used to determine the printed/non-printed pattern of all pels in an entire cell, where a cell comprises multiple pels. The following figure is meant to illustrate this.

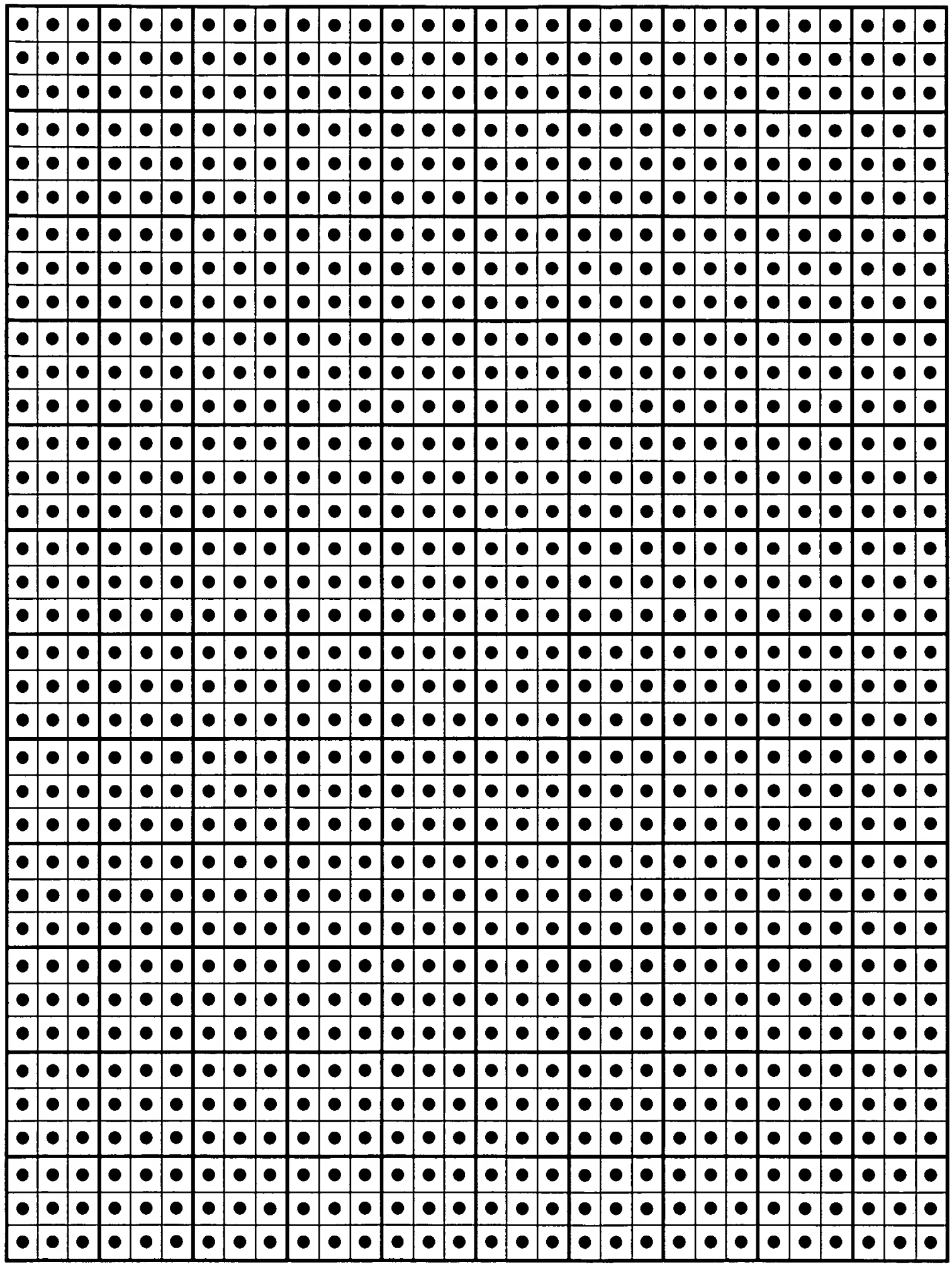


● = a value in the input data array

Thus, with this technique, each value in the input data array is used to determine whether each pel in an entire cell is to be printed or not printed. In the example provided, this means that each value in the input array is used to determined whether each of nine pels are printed or not printed. In the real world, this number can be much greater, as cells frequently contain many more than nine pels.

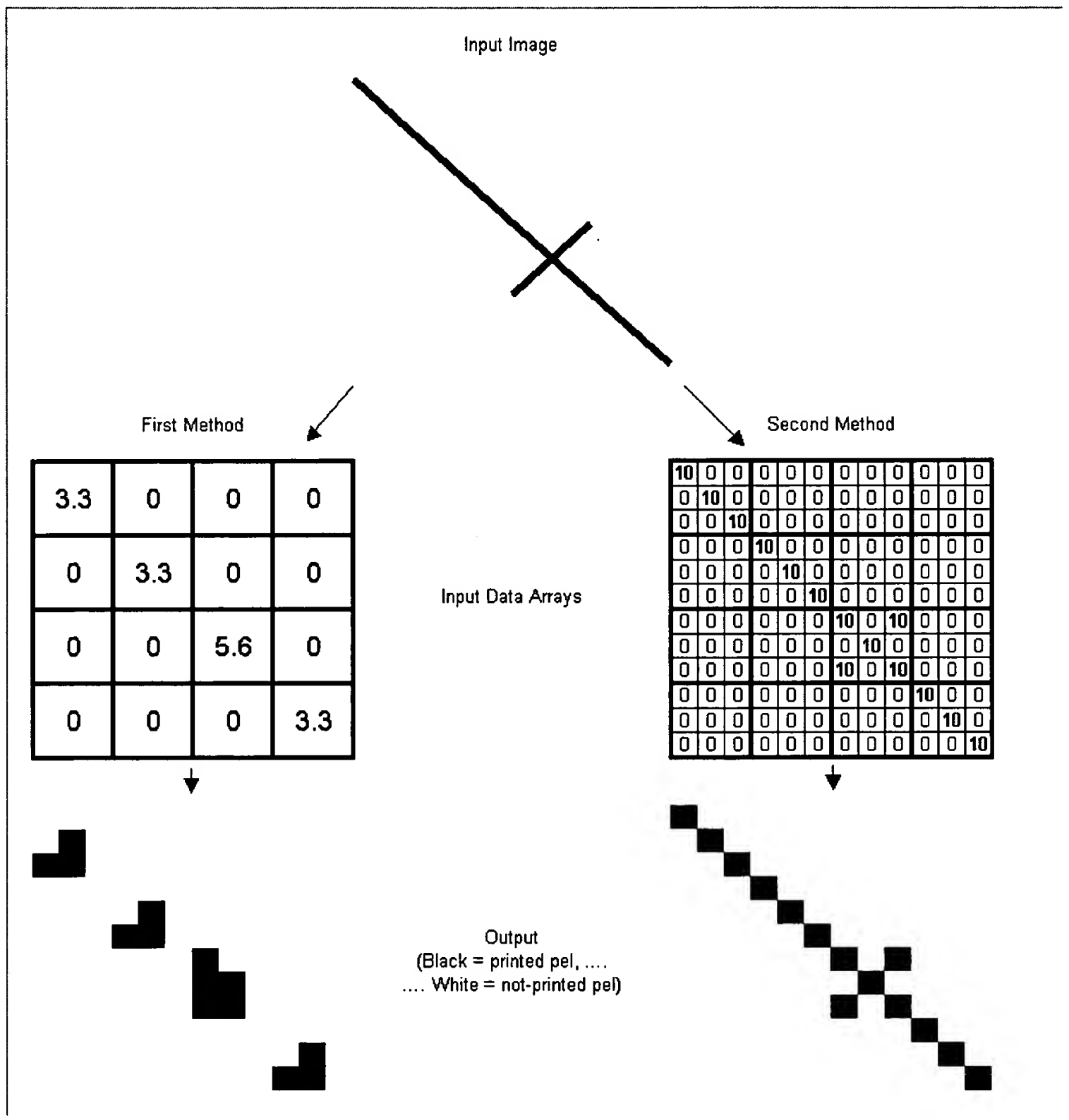
The image to be printed is represented as an array of numbers, with one number corresponding to the location of each cell. For instance, in order to print a 4-inch x 6-inch photograph in a 6-inch x 9-inch area on a piece of paper, using a printer with a resolution of 600 dots-per-inch (i.e., 600 pels per inch). Assuming that the 6-inch x 9-inch are on the piece of paper is the "output image area", and assuming that a cell is 3-pel x 3-pel square, the printer could print 200 cells per inch. Accordingly, the printer would print 1200 x 1800 "samples" of the image, one corresponding to the location of each cell that the printer will print in the "output image area". If the 4-inch x 6-inch photograph is scanned to create this input, it would be scanned at the rate of 300 samples per inch. (Note: 300 = 1200/4 = 1800/6). This means that each sample would have a numerical value representative of the density of the image in a square $1/300^{th}$ of an inch on each side. Assuming the collection of all 2.16 million number is the "input data array". (Note: 1200 x 1800 = 2,160,000).

A key characteristic in a "one-to-one" technique is that each number in the input data array is used to determine whether a single pel within a cell is printed or not printed. This means the input data array of the "one-to-one" method is larger than the input data array of the "one-to-many" technique by a factor equal to the number of pels in a cell. Because of this, the input data array in the "one-to-one" method contains more information about the image than the input data array in the "one-to-many" approach. This is illustrated by the following figure:



● = a value in the input data array

In the "one-to-one" approach, each value in the data input array is used to determine whether a single pel in a single cell is printed or not printed. In the example used, this means that each value in the input array is used to determine whether a corresponding pel of the nine pels of the cells is printed or not printed. Again, in the real world, this number can be much higher.



Thus, a basic difference between the present invention and the Sugino, Abe and Sakurada teachings is that Sugino, Abe and Sakurada each describes a "one-to-many" approach, while the present invention claims a "one-to-one" approach. Specifically, Applicants' independent claims recite that the "number of pels of the first plurality of pels is equal to the number of pels of the second plurality of pels." In these claims, the first plurality of pels is received as input data, and the second plurality of pels are grouped into basic cells as output data. Further, each independent claim specifies that multiple (e.g., n) pels of the first plurality of pels contribute to the output intensities of the n pels within each basic cell. Thus, in accordance with Applicants' recited invention, there is a "one-to-one" mapping between the number of input pels and the number of output pels.

More particularly, in one aspect, Applicants' claimed invention is directed to a technique for halftoning (e.g., claim 1). This technique includes receiving input data comprising a first plurality of pels having a first plurality of intensities, wherein the first plurality of intensities (Iin) are chosen from K intensity levels. The first plurality of pels are converted into a second plurality of pels having a second plurality of intensities, wherein the second plurality of intensities (Iout) are chosen from L intensity levels, wherein $L < K$, *and wherein the number of pels of the first plurality of pels is equal to the number of pels of the second plurality of pels.* At least some pels of the second plurality of pels are grouped into at least one basic cell. Each basic cell includes n pels of the second plurality of pels. The technique is further characterized by a maximum number of densities per each basic cell being greater than $(1 + n \times (L - 1))$ for a full range of constant input intensities (i.e., 0 to K) (Iin), and each intensity out (Iout) is chosen without reference to an intensity out of a neighboring pel, and n pels of the first plurality of pels contribute to the output intensities of the n pels within each basic cell.

It is well settled that there is no anticipation of a claim unless a single prior art reference discloses: (1) all the same elements of the claimed invention; (2) found in the same situation as the claimed invention; (3) united in the same way as the claimed invention; and (4) in order to perform the identical function as the claimed invention. In this instance, Sugino fails to disclose certain aspects of Applicants' invention as recited in the independent claims, and as a result, does not anticipate (or even render obvious) Applicants' invention.

Sugino describes an image processing method and apparatus for recording a color image with dots of different colors. The color image processing apparatus avoids uneven recording of data used to form the reproduced color image, which using a reduced memory capacity, by suitable deformation of square dot sub-matrixes within a square dot matrix used in halftone dot reproduction, to provide desired screen angles, and by reproducing different density levels with different arrangements of dots within the same dot matrix. (See Abstract of Sugino.)

Although Sugino describes halftoning, it is respectfully submitted that Sugino does not teach or suggest halftoning in accordance with Applicants' recited invention. Applicants respectfully submit that central to the final Office Action is a misunderstanding of the Sugino patent. Specifically, page 3, lines 8-12, the Office Action states:

> ... wherein the number of pels of the first plurality of pels is equal to the second number of pels of the second plurality of pels (high- and low-density dots (L=2) stored in screen dot memory, accessed in response to the pixel density signal, in <u>one-to-one</u> correspondence according to a position signal, from frame memory (column 3, lines 44-51) ... (Emphasis added.)

Applicants respectfully submit that the Office Action mischaracterizes the teachings of Sugino when asserting that the halftoning approach described therein is a one-to-one approach such as recited by Applicants (i.e., that the *number of pels of the first plurality of pels is equal to the number of pels of the second plurality of pels*). A careful reading of Sugino fails to uncover any discussion of a one-to-one correspondence between the number of pels of the first plurality of pels and the number of pels of the second plurality of pels. Again, in accordance with Applicants' invention, the first plurality of pels are received as the input data, and have a first plurality of intensities. These first plurality of pels are converted into a second plurality of pels, having a second plurality of intensities, and at least some pels of the second plurality of pels are grouped into at least one basic cell, each basic cell comprising n pels of the second plurality of pels. No similar halftoning process is taught or suggested by Sugino. A careful reading of Sugino clearly indicates that Sugino's halftoning process is a one-to-many algorithm, as evidenced by the following:

- Column 3, lines 23-33 of Sugino state:

> ... Said main and subsidiary scanning pulses are respectively supplied to frequency dividers 7, 8 for division by a number n, which is the number of rows or columns of a square dot matrix resembling the deformed dot matrix pattern constituting each recorded pixel in the printer 4, i.e., the number close to the square root of the number of dots in each screen dot pattern, and the divided main and subsidiary scanning pulses thus obtained are supplied to the input device 1 for reading the density signal of a pixel corresponding to the succeeding pixel recording position. (Emphasis added.)

Further, column 3, lines 62-65 state:

> ... The frequency dividers 7, 8 having a dividing ratio of 3, which is close to the square root of 8 corresponding to the number of dots in said deformed dot matrix.

Frequency dividers 7 & 8, which are illustrated in FIG. 1 & FIG. 2 of Sugino, necessitate that Sugino's algorithm is a one-to-many algorithm.

- The Examples of Sugino are focused on a 3 x 3 and 4 x 4 screen dot pattern. Screen dot patterns of these sizes result in "n" (dividers 7 & 8) being set to 3 and 4, respectively, according to the passages referenced above at column 3, lines 23+ and column 3, lines 62+. Further, column 4, lines 33 – 37 state:

> In the ink jet printer or laser beam printer commonly used for color image recording, each dot has to be composed of a 3 x 3 or 4 x 4 dot matrix providing approximately 32 density levels at maximum, because of the limitation in the density of recording dots...

- Additionally, all of the examples shown in FIGS. 3A, 3B, 4, 5A, 5B, 5C, 5D, 5E, 5F, 5G & 5H of Sugino contained "deformed dot" matrixes of a size large enough to cause "n" to be at least 3. (Here, "n" refers to the number by which dividers 7 & 8 are dividing the scanning signals.) These deformed matrixes all use between 8-dot and 20-dot patterns. This is evidenced by the teachings of the paragraph beginning at column 4, line 33 of Sugino.

- In the paragraph beginning at column 4, line 61 of Sugino, all the examples use matrixes of at least 16 dots, resulting in a selection of "n" of at least 4. (Here again, "n" refers to the number by which dividers 7 & 8 are dividing the scanning signals.)

The above-noted teachings of Sugino contain the only references to a method to calculate "n", i.e., the number by which dividers 7 & 8 are dividing the scanning signals. Additionally, these references provide strong evidence that Sugino is focused exclusively on matrixes of a size that would cause dividers 7 & 8 to divide by at least 3, according to the Sugino method of calculating "n". Thus, there is not a single example in Sugino of a one-to-one algorithm. To therefore characterize the teachings of Sugino as comprising a one-to-one algorithm is believed to be a misinterpretation of Sugino. There is no mention anywhere in Sugino of the advantages, value and importance of a one-to-one algorithm as taught and described by the present application.

Since Sugino clearly teaches a "one-to-many" halftoning approach, and Applicants clearly recite a "one-to-one" halftoning approach (i.e., the number of pels of the first plurality of pels is equal to the number of pels of the second plurality of pels), Applicants respectfully submit that there is no anticipation of their recited invention based upon the teachings of Sugino. Reconsideration and withdrawal of the rejection is therefore respectfully requested.

Further, Applicants respectfully submit that it would not have been obvious to one of ordinary skill in the art to modify the teachings of Sugino to arrive at a one-to-one approach (wherein the number of pels of the first plurality of pels is equal to the number of pels of the second plurality of pels) as recited by Applicants. For the Sugino algorithm to be a "one-to-one" algorithm, a new density signal would need to be presented by the input device (labeled 1 in both FIG. 1 & FIG. 2 of Sugino) every time there is a main scanning pulse or a sub-scanning pulse produced by the printer (labeled 4 in FIG. 1 & FIG. 2 of Sugino). Dividing the scanning pulses with dividers 7 & 8, prevents this from happening, and forces Sugino to be a "one-to-many" algorithm. Still further, modifying the Sugino algorithm to arrive at a one-to-one approach would destroy the capability of Sugino to reproduce a color image. In such a modification, there would be no grey levels, which are necessary to render a reproduced image understandable. Clearly, Sugino is not extendable to an approach such as recited by Applicants.

For the above reasons, Applicants respectfully submit that their recited invention, in addition to not being anticipated by Sugino, would not have been obvious to one of ordinary skill in the art based thereon.

The dependent claims at issue are believed allowable for the same reasons as their respective independent claims, as well as for their own additional characterizations. In this regard, both Abe and Sakurada describe a "one-to-many" halftoning approach. For example, in Abe's figures, a cell is a 3 x 3 array of pels. Sakurada is also a "one-to-many" halftoning approach. For example, reference column 2, of Sakurada, where one pel in determines a basic cell output, that is, there is a shift in resolution. Since none of the applied art presents a facility for obtaining an enhanced number of density levels for a basic cell in a halftoning approach that is a "one-to-one" resolution approach (as recited by Applicants, wherein "the number of pels in the first plurality of pels is equal to the number of pels in the second plurality of pels"), Applicants respectfully submit that there is no teaching or suggestion of their recited invention based on any combination thereof.

Further, Applicants note that both Abe and Sakurada are recited in the Office Action for various characteristics of the dependent claims at issue. Without acquiescing to the characterizations of these patents set forth in the Office Action, Applicants respectfully submit that neither patent teaches or suggests the above-noted deficiencies of Sugino when applied against the independent claims at issue.

For all the above reasons, Applicants respectfully submit that all claims are in condition for allowance and such action is respectfully requested.

Applicants' undersigned attorney is available should the Examiner wish to discuss this application further.

Respectfully submitted,

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